AMENDMENTS TO THE CLAIMS

The following listing of claims will replace all prior versions and listings of claims in the application.

LISTING OF CLAIMS

1. – 28.   (Cancelled)

29. (New)   Method for the recognition and tracking of objects on the basis of images of at least one real object (16, 18) including depth resolved image points (26, 28, 28', 32, 33) detected in time sequence by at least one sensor (10) for an electromagnetic radiation, in particular a laser scanner, with the real object (16, 18) being in a detection range of the sensor (10), in which the following steps are carried out in sequential cycles:

- at least one current object contour is formed from image points (26, 28, 28', 32, 33) of a current image,

- for objects in a preceding cycle at least one object contour is predicted in the current cycle starting in each case from an object contour associated with the respective object in the preceding cycle,

- for at least one of the objects a current position is determined from the current object contour and/or an object speed is determined from the current object contour (42) and the object contour in a preceding cycle.

30. (New) Method in accordance with claim 29,

characterized in that

for the formation of current object contours segments are formed from image points (26, 28, 28', 32, 33) of a current image;

in that for each of the segments a segment contour (30) associated with the segment and its position are determined;

in that one of the segment contours is compared with at least one of the predicted object contours with reference to the position and/or the shape and in dependence of the result of a comparison the segment corresponding to the segment contour is associated with one of the objects and in that current object contours (42) are respectively formed from the segments respectively associated with the segment contours of objects.

31. (New) Method in accordance with claim 29,

in that contours are defined by a contour element or by a sequence of contour elements (30, 38, 42) and in that the contour element or data defining the contour elements (30, 38, 42) are determined from at least one image point (26, 28, 28', 32, 33) of a segment or contour elements of another contour.

32. (New) Method in accordance with claim 31,

characterized in that

the contour elements (30, 38, 42) respectively include position coordinates as data.

33. (New) Method in accordance with claim 31,

characterized in that

for the formation of a contour element (30) of a segment contour a predetermined number of sequential image points (26, 28, 28', 32, 33) of the segment with polar angles which increase or reduce in a series with respect to

a predetermined polar axis are associated with a corresponding contour element and in that data of the contour element is determined from the image point (26, 28, 28', 32, 32).

34. (New) Method in accordance with claim 31,

characterized in that

for the formation of a contour element (30, 38, 42) of a segment contour respective sequential image points (26, 28, 28', 32, 33) of the segment in a series of increasing or decreasing polar angle with respect to a predetermined polar axis are associated with a corresponding contour element the spacing of which from a first image point (26) associated with the contour element is smaller than a predetermined maximum spacing and in that data of the contour element are determined from these image points (26, 28, 28', 32, 33).

35. (New) Method in accordance with claim 31,

characterized in that

contour elements are obtained by vectorization of a curve which arises by connecting the image points (26, 28, 28', 32, 33) of a segment in a series of increasing or decreasing polar angle with reference to a predetermined polar axis.

36. (New) Method in accordance with claim 31,

characterized in that

the positions of the image points (26, 28, 28', 32, 33) of a segment are subjected to low pass filtering prior to the formation of the contour elements.

37. (New) Method in accordance with claim 31,

characterized in that

a quality is associated with at least one contour element which depends on the position of the image points (26, 28, 28', 32, 33) used for the determination of the contour element.

38. (New) Method in accordance with claim 29,

characterized in that,

for the prediction of the position of an object contour in a current cycle, an object speed determined in a preceding cycle is used.

39. (New) Method in accordance with claim 29,

characterized in that

a capture region is associated with each object and in that a segment contour of a segment is only compared with an object contour of an object in the capture region of which at least one reference point of the respective segment lies.

40. (New) Method in accordance with claim 29,

characterized in that,

for the comparison of a segment contour with an object contour, an association quality is determined for a segment and an object which is a measure for the agreement of the respective contours with respect to position and/or shape and

in that a segment which can be associated with two objects is associated with that object for which it has the best value of the association quality.

41. (New) Method in accordance with claim 31,

characterized in that,

for the comparison of a segment contour with an object contour, an association quality is determined for a segment and an object which is a measure for the agreement of the respective contours with respect to position and/or shape and in that a segment which can be associated with two objects is associated with that object for which it has the best value of the association quality;

and in that from pairs respectively consisting of a contour element of the segment contour and a contour element of the object contour, differences are determined between corresponding data of the contour elements and in that the association quality is determined using the differences.

42. (New) Method in accordance with claim 31,

characterized in that,

for the comparison of a segment contour with an object contour, an association quality is determined for a segment and an object which is a measure for the agreement of the respective contours with respect to position and/or shape and in that a segment which can be associated with two objects is associated with that object for which it has the best value of the association quality;

and in that pairs respectively consisting of a contour element of the segment contour and a contour element of the object contour are determined among the contour elements of the segment contour and the contour elements of the

object contour which at most differ in one item of the data by a predetermined amount and in that the number of these pairs is determined for the determination of the association quality.

43. (New) Method in accordance with claim 31,

characterized in that

for the comparison of a segment contour with an object contour, an association quality is determined for a segment and an object which is a measure for the agreement of the respective contours with respect to position and/or shape and in that a segment which can be associated with two objects is associated with that object for which it has the best value of the association quality;

and in that pairs respectively consisting of a contour element of the segment contour and a contour element of the object contour are determined among the contour elements of the segment contour and contour elements of the object contour for which position coordinates have a spacing which is smaller than a predetermined maximum pair spacing and in that the number of these pairs is determined for the determination of the association quality.

44. (New) Method in accordance with claim 31,

characterized in that

for the comparison of a segment contour with an object contour, an association quality is determined for a segment and an object which is a measure for the agreement of the respective contours with respect to position and/or shape and in that a segment which can be associated with two objects is associated with that object for which it has the best value of the association quality;

and in that for the determination of the association quality a contour element of the segment contour and a contour element of the object contour are determined for which the position coordinates have the smallest spacing among all pairs of contour elements of the segment contour and contour elements of the object contour.

45. (New) Method in accordance with claim 29,

characterized in that

two or more segments are only then associated with an object when a spacing of the segments from the object is respectively smaller than a predetermined maximum spacing.

46. (New) Method in accordance with claim 29,

characterized in that

a hiding recognition is executed during the association of segments to objects.

47. (New) Method in accordance claim 29,

characterized in that

when recognizing at least two segments which can be associated with the same object, but which should not both be associated with the same object, the segment with the better association quality is associated with the object.

48. (New) Method in accordance with claim 29,

characterized in that

for the determination of the object speed a difference is determined between the position and/or the orientation of the current object contour and the position and/or orientation of the object contour in the preceding cycle or the predicted object contour.

49. (New) Method in accordance with claim 31,

characterized in that

in the determination of the difference between the position and/or orientation of the object in the current cycle and the position and/or orientation of the object contour in the preceding cycle, or the predicted object contour, contour elements (42) of the current object contour and contour elements (38) of the object contour in the preceding cycle or of the predicted contour are associated with one another and in that the change of the position and/or orientation of the object contour in the preceding cycle to that in the current cycle is determined from those contour elements (42) of the current contour which are associated with contour elements (38) of the object contour in the preceding cycle or of the predicted object contour.

50. (New) Method in accordance with claim 31,

characterized in that

for the association of contour elements (38, 42) of two object contours relative to one another, starting from contour elements (44, 44') of the object contours with position coordinates which respectively correspond to one end of the contour, a search is in each case made, for sequential contour elements along one of the two contours, for a corresponding not yet associated contour

element of the other contour of which the position coordinates have a minimum spacing from the position coordinates of the contour element of the one contour.

51. (New) Method in accordance with claim 31,

characterized in that

in each case at least one reference element (44, 44') is determined for an object contour (38, 42); in that, for the association of object elements (38) of the predicted contour and object elements (42) of the current object contour, a correction shift is found between the reference elements (44, 44') of the predicted contour and the current contour and in that the association of contour elements of the predicted contour to contour elements of the current contour takes place using the contour elements of the predicted contour shifted by the correction shift of the reference elements.

52. (New) Method in accordance with claim 31,

characterized in that

differences between the position coordinates of mutually associated contour elements (42; 38) of the current contour and of the contour determined in the preceding cycle or of the predicted contour are first determined; in that a translation and/or a rotation of the object between the preceding cycle and the current cycle is determined from these differences and in that the object speed is determined on the basis of this translation and/or rotation.

53. (New) Method in accordance with claim 29,

characterized in that

the object speeds are subjected to a low pass filtering operation.

54. (New) Computer program having program code means for carrying out a method for the recognition and tracking of objects on the basis of images of at least one real object (16, 18) including depth resolved image points (26, 28, 28', 32, 33) detected in time sequence by at least one sensor (10) for an electromagnetic radiation, in particular a laser scanner, with the real object (16, 18) being in a detection range of the sensor (10), in which the following steps are carried out in sequential cycles:

- at least one current object contour is formed from image points (26, 28, 28', 32, 33) of a current image,

- for objects in a preceding cycle at least one object contour is predicted in the current cycle starting in each case from an object contour associated with the respective object in the preceding cycle,

- for at least one of the objects a current position is determined from the current object contour and/or an object speed is determined from the current object contour (42) and the object contour in a preceding cycle,

said program being executed on a computer (24).

55. (New) Computer program product with program code means which are stored on a computer readable data carrier in order to carry out the method for the recognition and tracking of objects on the basis of images of at least one real object (16, 18) including depth resolved image points (26, 28, 28', 32, 33)

detected in time sequence by at least one sensor (10) for an electromagnetic radiation, in particular a laser scanner, with the real object (16, 18) being in a detection range of the sensor (10), in which the following steps are carried out in sequential cycles:

- at least one current object contour is formed from image points (26, 28, 28', 32, 33) of a current image,

- for objects in a preceding cycle at least one object contour is predicted in the current cycle starting in each case from an object contour associated with the respective object in the preceding cycle,

- for at least one of the objects a current position is determined from the current object contour and/or an object speed is determined from the current object contour (42) and the object contour in a preceding cycle

said computer program product being executed on a computer (24).

56. (New) Apparatus for the recognition and tracking of objects with at least one optoelectronic sensor (10), in particular a laser scanner, the viewing range of which includes the detection range (14) and

a data processing device (24) associated with the optoelectronic sensor (19), said data processing device being designed to carry out a method for the recognition and tracking of objects on the basis of images of at least one real object (16, 18) including depth resolved image points (26, 28, 28', 32, 33) detected in time sequence by at least one sensor (10) for an electromagnetic radiation, in particular a laser scanner, with the real object (16, 18) being in a detection range of the sensor (10), in which the following steps are carried out in sequential cycles:

- at least one current object contour is formed from image points (26, 28, 28', 32, 33) of a current image,

- for objects in a preceding cycle at least one object contour is predicted in the current cycle starting in each case from an object contour associated with the respective object in the preceding cycle,

- for at least one of the objects a current position is determined from the current object contour and/or an object speed is determined from the current object contour (42) and the object contour in a preceding cycle.